

***TRINATIONAL SARDINE FORUM  
PROCEEDINGS***

***Interim Report of the first meeting***

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T. Baumgartner**

**Ensenada, Baja California, México  
November 29-30, 2000**

**Administrative Report SWFSC-LJ-01-06**

This is an interim report of the proceedings of the first Trinational Sardine Forum held at the Municipal Conference Center in the old Hotel Riviera in Ensenada, México, November 29-30, 2000. Over forty participants representing the industry, governmental agencies and academic institutions from Canada, México and the U.S attended the Forum. The meeting was supported by contributions from the municipality of Ensenada, through the office of the mayor, the Southwest Fisheries Science Center in La Jolla, California, and the Eastern Pacific Consortium of the Inter-American Institute for Global Change Research (EPCOR-IAI), California Sea Grant and CICESE. The latter two provided simultaneous translation in English and Spanish. Grupo de los II (a collaborative group of fishing industry, academic and agency representation from Ensenada) made the arrangements for meeting facilities and provided liaison with Mayor's Office of Ensenada. A more extensive final report is being prepared by the EPOC-IAI Office at CICESE (Ensenada, Mexico) which shall contain minutes in Spanish and English, abstracts of the presentations, as well as the materials presented in this Interim Report.

The meeting was Co-Chaired and the proceedings edited by John Hunter and Tim Baumgartner and the interim may be cited as:

Hunter, J. R. and T. Baumgartner (editors). 2001. Trinational Sardine Forum Proceedings for the year 2000 (Interim Report of the first meeting). Administrative Report of the Southwest Fisheries Science Center LJ-01-06 pp 1-25.

## ABSTRACT

The first Trinational Sardine Forum was held in Ensenada, México from November 29-30, 2000 to provide the opportunity for discussion of the common fisheries issues in Canada, México and the U.S., and to develop an implementation plan that will provide base-line data needed for the coast-wide assessment of the Pacific sardine population. The implementation plan contains the following four elements: 1) Provide samples of sardine age, length and reproductive state from regions not currently fished with contributions by industry of the necessary vessel trips to make the collections; 2) Establish a common trinational sardine data base in Ensenada available to all Forum members on a Web site, maintained through cost sharing by Canada, U.S., and México; 3) Provide regional biomass estimates based on: (a) NWFSC egg surveys off Oregon enhanced with NWFSC trawl surveys of adult sardine facilitated by an industry spotter plane, (b) spawning biomass estimates from southern Baja California to San Francisco based on combining data from CalCOFI and IMECOCAL, (c) regional indices of sardine abundance for Oregon and Washington NWFSC trawl surveys, (d) regional indices of sardine abundance west of Vancouver Island based on Canadian trawl surveys, and (e) U.S.-Canadian January survey in 2001 using a Canadian research vessel; and 4) Develop a program to identify different spawning stocks of sardines that are temperature specific and can be distinguished from vertebral counts.

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# PROCEEDINGS OF THE FIRST TRINATIONAL SARDINE FORUM

## BACKGROUND

Sardine fisheries exist once again along the coast of North America from Baja California, México to British Columbia, Canada. An accurate coast-wide assessment of this widely distributed stock is needed because: 1) the fishery independent measures of abundance cover only a fraction of the full range of the population; 2) the sardine fishery takes only a near-shore, often younger, fraction of the stock leaving the offshore fraction, of presumably larger and older fish, unsampled; 3) age and growth measurements are confounded by movements along the coast which are presently largely unknown; and 4) basic life table information need to be updated.

To address the lack of information, a three-day symposium (*Sardine Symposium 2000*<sup>1</sup>) on the resurgent Pacific sardine population was convened in La Jolla, California at Scripps Institution of Oceanography, May 23-25, 2000. The group concluded that future advances in assessing the sardine will depend upon the pooling of information, and in-kind contributions mainly from the fishing industry and fishery agencies throughout its range. Although no representatives of the Mexican Industry were present, the Canadian and U.S. industry representatives expressed a willingness to contribute to the coast-wide collection of information needed to assess the sardine population. Participants recommended the formation of a Trinational Sardine Forum to implement and coordinate coast-wide collection of the data for sardine stock assessment, and to exchange information, and keep abreast of trends in the fishery. The forum would meet annually and be attended by industry, fishery agency and academic scientists from Canada, México and the U.S. The Forum was charged with implementing the research recommendations set forth by the Sardine 2000 Symposium. Ensenada, México was selected as the site for the Forum to ensure strong participation of the Mexican industry.

## OBJECTIVES

Objectives of the first meeting were to present and discuss current trends and events in the west coast fisheries for sardine to determine the level of collaboration that is practical and necessary among the industry, government agencies and academic institutions from Canada, the United States and México to implement a coast-wide assessment and monitoring of sardine; and, to begin collaborative implementation of the research recommendations of Sardine 2000. Those recommendations, were too numerous and costly to be implemented in total by Forum collaboration. To facilitate implementation the conveners distributed a shorter annotated list of the Sardine 2000 recommendations (Appendix 1) that provides a more realistic set of goals for the Forum.

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<sup>1</sup>Phillips, Stephen (editor), 2000. Proceedings of the Sardine Symposium 2000. May 23-25, 2000. Pacific States Marine Fisheries Commission, Gladstone, Oregon, 141 pp.

## **RESULTS**

### **Summary Of Current Events And Trends**

The meeting opened with national anthems of México, U.S., and Canada. The Mayor of Ensenada gave an opening address in which he pointed out that about 20 companies in Ensenada are presently processing sardines. Invited representatives from the industry, agencies and academic institutions from the countries were introduced and asked to say a few words. The discussion then turned to reports on landings, stock assessments, and other fishery matters. The U.S. stock assessment provided an estimate of 1.2 million MT of sardine in 2000 based on the CANSAR two area model, and harvest guidelines for U.S. fishers was set at 186 MT although the U.S. fishery was expected to take only about 60,000 MT. The Mexican fishery landed 54,000 MT in 2000. Both U.S. and Mexican fisheries are composed primarily of 1 and 2-year old fish. The Canadians which take much larger and older sardine, mentioned that they assume 10% of the population biomass is in British Columbia and base their quotas on that amount. Catch in Canada may reach 1600 MT in 2000, with a limited expansion planned for 2001. The British Columbian fishers are focusing on high value markets such as tuna long line bait and sushi markets. The State of Washington had a trial fishery in 2000 that landed 4792 MT and Oregon landed 9500 MT in 2000, and both of these fisheries are expected to expand. In the 99/00 season, catch of sardine landed at the three Mexican ports in the Gulf of California was 63,000 MT.

There was considerable discussion stemming from questions by the Mexican agency scientists and industry regarding a feature of the U.S. harvest formula that constrains the U.S. fishery to 87% of the biomass estimate. It was pointed out that this figure is not based on any international agreement, nor has any legal implications regarding allocation of catch between U.S. and Mexico. Eighty-seven percent is a rule of thumb used in the U.S. Coastal Pelagic Management Plan to indicate the proportion of the stock north of Point Eugenia, which may be available to U.S. fishermen.

### **Implementation Planning**

The annotated list of potential sardine projects from Sardine 2000 (Appendix I) was discussed by the group in the plenary session. The group concluded that the most cost effective topics for improving coast-wide stock assessment and monitoring through Forum collaboration were: coast-wide coordinated sampling for age, size composition and reproductive state; regional biomass estimates; and development of a common data base for size, age and landings information. Subsequently, a small group wished to also implement the use of vertebral counts as a way to identify temperature specific spawning habitats. The Forum broke into working groups charged with writing draft implementation plans for each of these topics. The plans describe objectives and approaches, identify contact people and agencies that had agreed to cooperate, specifying delivery dates for the information, and identifying contributions.

These activities shall provide new information on age and size structure of the population, regional biomass, reproduction, and movements thereby enabling the development, for the first time, of a coast-wide stock assessment model that takes into account distribution and movements

of sardines over their full geographic range. A target of 2002 was set for the development of the model, provided that these plans are implemented. Lastly, the Forum agreed to meet again near the end of November 2001 in Ensenada to measure progress in the implementation, and to discuss current events in this trilateral fishery.

## **IMPLEMENTATION PLANS**

### **Working Group 1 - Industry Supported Directed Sardine Sampling**

Rapporteur: Tim Baumgartner,

#### Working Group Participants:

Martin Gutierrez, BGB Internacional, Mexico  
 Cesar Garcia, Conservas San Carlos, Mexico  
 Walterio Garcia Franco, Carretera Tijuana-Ensenada, Mexico  
 Irma Maldonado, Conservas San Carlos, Mexico  
 Roberto Lopez, Procesadora Océanos, Mexico  
 Ragnar Guttierrez A., Productos Marinos ABC, Mexico  
 John Hunter, National Marine Fisheries Service, USA  
 Tim Baumgartner, CICESE, Mexico  
 Don Pepper, Pacific Sardine Association, Canada  
 Orlando Amoroso, Southern California Commercial Fishing Association, USA  
 Jim Morgan, National Marine Fisheries Service, USA  
 Bob Seidel, Astoria Holdings, USA  
 Paul Smith, National Marine Fisheries Service, USA  
 John Royal, USA  
 Dan Waldeck, Pacific Fishery Management Council, USA  
 Jerry Thon, Astoria Holdings, USA  
 Daniel Loya, CICESE, Mexico  
 Casimiro QuiZonez, CICIMAR, Mexico  
 Dennis Chalmers, Department of Fisheries and Oceans, Canada

Objectives: Improve knowledge of age structure and reproductive rates.

#### Cooperating Organizations:

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
CRIP-INP, Ensenada	Walterio Garcia	wgarcia@telnor.net
CICESE, Ensenada	Tim Baumgartner	tbaumgar@cicese.mx
CICIMAR La Paz	Casimiro QuiZonez	cquinone@redipn.ipn.mx
Department of Fisheries and Oceans	Dennis Chalmers	chalmersd@pac.dfo.-mpo.gc.ca
National Marine Fisheries Service	John Hunter	john.hunter@noaa.gov
California Department of Fish and Game	Kevin Hill	khill@ucsd.edu
U.S industry	Orlando Amoroso	oamoroso@aol.com
Mexican Industry	Martin Gutierrez	bgbgrupo@telnor.net

Approach: A coast-wide assessment requires accurate description of age and size structure of sardines over the entire coast, and accurate measurements of maturity and spawning rates. Presently, sardine fishing (the primary source of specimens) is confined to a narrow band along the coast and fishing is limited to certain seasons. These spatial and temporal biases in sampling, combined with extensive coastal movements of sardine leads to major uncertainties in estimating the size and age structure of the sardine population; the most vital data for a stock assessment. For example, the large sardines fished in the north in summer are usually not taken by the southern fisheries, but they may be the source of the extensive offshore egg patches in the south that exist far beyond the range of the southern fisheries. Summer spawning occurs in the north but resultant juveniles are not taken by the northern fishery and the role of these northern recruits remains obscure. Similarly, the extent that the southern fisheries in San Pedro and Ensenada depend upon summer migrations of sardine spawned in southern Baja California is unknown. In addition, most spawning appears to occur offshore of traditional sardine fishing grounds in all areas of the coast. Data on reproductive rates are weak and out of date.

This proposed project will provide industry-supported sampling of sardines to reduce the major uncertainties in age and size structure, and reproductive rates by sampling in unfished regions. Three sampling plans were identified.

#### ***1. April: 30-39°N Offshore Spawning Habitat (Fig 1A)***

Sample sardines in April to determine the size age and reproductive rates of the spawners producing the extensive distribution of offshore spawn off central and southern California, U.S. and off northern Baja California. Underway in April, CalCOFI and IMECOCAL surveys shall transmit to Fishing Captains and Forum Observers, the location of major concentrations of sardine spawn. Vessels shall go to these areas and capture fish, and observers shall process and preserve spawners on board. Target sample size, per school or per set is 100 females with active ovaries. The number of such sets or schools sampled will be dictated by costs and weather. Since such data have never been collected even one sample of 100 fish from the offshore spawning region is of great value, every additional sample makes it more likely that the samples accurately represent the spawning stock. The ideal sample size (if cost were no consideration) would be about 60 positive sets of 25 females each that covered the entire spawning habitat.

#### ***2. January: Southern Baja California Spawning Habitat (Fig 1B)***

Sample sardines in January to determine the size, age and reproductive rates of the spawners producing spawn in southern Baja California. Underway IMECOCAL January surveys shall transmit to Fishing Captains and Forum Observers, the location of major concentrations of sardine spawn. Vessels shall go to these areas and capture fish, and observers shall process and preserve spawners on board. Target sample size, per school is 100 females with active ovaries. The number of samples will be dictated by costs and weather. Since such data have never been collected even one sample of 100 fish from the offshore spawning region is of great value, every additional sample makes it more likely that the samples accurately represent the spawning stock. The ideal sample size (if cost were no consideration) would be about 60 positive sets of 25 females each that covered the entire spawning habitat.



### ***3. Summer: Synchronized Coast-Wide Sampling (Fig 1C)***

The objective of this sampling approach is to obtain a representative sample of the size and age of the entire stock during a short period of coordinated sampling along the entire coast. Using such a synchronized sampling strategy that would eliminate biases caused by counting the same fish twice or entirely missing an age component in a region, as is presently the case. In this approach, samples from the catch and those from directed sampling of unfished areas offshore of the traditional fishing grounds would be needed. It would also be useful to have at least crude regional estimates of the biomass from each region so that the proper statistical weights could be applied to the synchronized coastal sampling.

Start Dates: Sampling approaches 1 and 2 were judged to be practical to implement in time to deliver the information needed for a coast-wide sardine assessment model scheduled to be developed by NMFS and CDF&G for the 2002 stock assessment. Industry representatives expressed a willingness to work with their agency or University counterparts in developing a sampling strategy to support approaches 1 and 2. Industry representatives from San Pedro judged it possible to implement Approach 1 by April 2001, and the Ensenada group plan to implement Approach 2 in January 2002. Approach 3, a synchronized coast-wide summer, was deferred until after 1 and 2 have been implemented. While approach 3 is highly desirable, it is a more costly and complex operation.

Reporting Method: The data and a summary of the resulting analysis shall be posted on the Web site of the Trinational Sardine Forum, shall be presented at the next meeting of the Forum scheduled for November 2001 in Ensenada, México. These data shall be incorporated into the coast-wide assessment model that will be developed for sardine in 2002.

#### Reporting Deadlines:

January 2001: Mexican Industry (Ensenada) - University-Agency (CICESE, INP, Grupo-II) planning meeting for implementation approach 1 in April 2001

February 2001: U.S. Industry (San Pedro and Monterey)-agency (NMFS CDF&G) planning meeting for implementing sardine approach 1, in April 2001

March 2001: Develop a firm Industry-agency agreement on conduct of cooperative April surveys.

April 2001: Conduct industry supported sampling of sardine following procedures outlined under approach 1.

October 2001: Mexican Industry (Ensenada, San Carlos, Guaymas) ... approach 2, January 2002.

November 2001: Post results of specimen analysis from April survey on web and present results at Trinational Sardine Forum. Have a Forum discussion of a continuation of sampling for April 2002.

January 2002: Conduct Mexican industry supported sampling of sardine following procedures outlined under approach 1.

## **Working Group 2 - Compilation and Management of Existing Sardine Databases**

Rapporteur: Kevin Hill, California Department of Fish and Game

### Working Group Participants:

Walterio Garcia Franco - Instituto Nacional de la Pesca, Ensenada, México  
 Dave Smith - British Columbia Ministry of Fisheries, Canada  
 Dennis Chalmers - Department of Fisheries and Oceans, Canada  
 Michele Robinson - Washington Department of Fish and Wildlife, USA  
 Jean McCrae - Oregon Department of Fish and Wildlife, USA  
 John Butler - Southwest Fisheries Science Center, USA  
 Kevin Hill - California Department of Fish and Game, USA  
 Casimiro Quinonez –CICIMAR, Mexico

Objective: Provide a depository for existing sardine data that will be accessible by the cooperating organizations and updated on a regular basis by a dedicated data manager.

### Cooperating Organizations:

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
CRIP-INP, Ensenada	Walterio Garcia	wgarcia@telnor.net
CICIMAR, La Paz	Casimiro Quinonez	cquinone@redipn.ipn.mx
CICESE, Ensenada	Tim Baumgartner	tbaumgar@cicese.mx
Department of Fisheries and Oceans	Angela McDiarmid	mediarmida@pac.dfo-mpo.gc.ca
National Marine Fisheries Service	John Butler	jbutler@ucsd.edu
Washington Department of Fish & Wildlife	Michele Robinson	robinmkr@dfw.wa.gov
Oregon Department of Fish and Wildlife	Jean McCrae	jean.mccrae@hmsc.orst.edu
California Department of Fish and Game	Kevin Hill	khill@ucsd.edu

Approach: Fishery-dependent (port sample, landings) and fishery-independent (sea survey) data for sardine are now collected on a routine basis by research and resource-management agencies in México, the United States, and Canada. Databases include basic biological information (length, weight, age, sex, maturity), and information on landings by port area. The data have a broad range of uses by each entity, and some data exchange currently exists between agencies. The proposed project will make west coast Pacific sardine data more readily accessible to fisheries researchers and resource managers for the purposes of coast-wide research, assessment, and monitoring.

Each of the participating organizations agreed that it would be best to house the databases in a single depository to be coordinated by a data manager. Tim Baumgartner (CICESE) offered to hire and supervise a data manager at CICESE, (Ensenada, Baja California) contingent on

availability of \$4,000 in external funds. John Hunter (NMFS, La Jolla) and Dennis Chalmers (DFO, Canada) committed to sharing this cost, which would be administered through a CalCOFI account. Tim Baumgartner anticipates being able to hire a data manager in Spring 2001.

The working group participants agreed to assemble background information, or 'metadata', prior to the data manager's start date. This preliminary task will involve compiling lists of existing databases and describing their contents in detail, including: range of years sampled, sampling protocols, database structure (e.g. flat vs. relational, field types and lengths), data file type (Excel, dBASE, Access), and a description of each variable (units, coding, other pertinent information). The participants agreed to compile this metadata and submit it to Kevin Hill (CDF&G) by the end of January 2001.

Once hired, the data manager will develop a Web site that will serve as a depository and server for files shared by each organization. The data manager will be responsible for gathering data files from each agency, standardizing and ensuring uniformity of the data, and posting regular updates of files on the Web site. Agencies submitting data will be responsible for removing all confidential information (e.g. vessel or fisherman identity) prior to submitting to the data manager.

Working group participants discussed the types of data common to their respective port sampling programs. Common data collected include: date, port, landing weight, sample weight, and measurements taken for individual specimens (standard and fork lengths, body weight, sex, general reproductive condition, and age as estimated by otoliths). Various coding schemes have been used to describe sexual maturity, so the group identified the need to simplify the code to three stages: immature, active, and hydrated. Existing coding schemes will be continued to allow standardization across methods. In addition, the group discussed the need to conduct otolith cross-readings to identify potential discrepancies or biases in age estimates within and among agencies. No procedures or deadlines toward this goal were established, but this will be a high priority item once the basic data sharing process has been implemented.

Data from various fishery-independent surveys also exist in formats similar to port samples, but the source and nature of these data sets were too broad to warrant detailed discussion by the group. The group did agree, however, that survey sample data should be kept separate from port sample data, and that some degree of uniformity and access should be agreed upon for future surveys such as the coast-wide sampling effort being pursued at this forum.

The third database type identified was that of landings by the commercial sardine fishery. The group agreed that individual landing receipt data were neither of interest nor practical, and that summaries of sardine landed by month and port area would satisfy the needs of each organization. Historical data sets were also briefly discussed. Kevin Hill offered to share data files of catch, age and length composition digitized from historical Fish and Game publications.

Start Date: Agency contacts present at the meeting agreed to compile lists of existing databases and to document the content and format of the data files by January 31, 2001. Kevin Hill will compile metadata reports and transmit them to the new data manager. Web site development and

routine database management tasks will not begin until an individual is hired by Tim Baumgartner.

Reporting Method: Electronic data files should be submitted to the data manager via Email, diskette, or CD-ROM. A short progress report will be written on an annual basis for presentation at the Forum each year.

Reporting Deadlines:

Metadata summary reports will be due to Kevin Hill by January 31, 2001 (first year).

Data submissions and updates will be sent to the data manager (CICESE) by July 31 of each year. The July deadline will provide sufficient time for ageing of samples from the previous season for incorporation into the annual sardine stock assessment process.

The annual progress report should be submitted to the Forum organizers one month prior to the annual meeting.

**Working Group 3 - Regional Estimates of Biomass (Fig 2)**

Rapporteur: Nancy Lo, National Marine Fisheries Service, Southwest Fisheries Science Center

Working Group Participants:

Martin E. Hernandez Rivas, CICIMAR, Mexico  
 Sandy McFarlane, Department of Fisheries and Oceans, Canada  
 Robert Emmett, National Marine Fisheries Service, USA  
 Ray Conser, National Marine Fisheries Service, USA  
 Sarita De la Campa, CICESE, Mexico  
 Darrell Kapp, Astoria Pacific Seafood, USA  
 Nancy C.H. Lo, National Marine Fisheries Service, USA  
 Yanira Green, Instituto Nacional de la Pesca, Mexico

***1. IMECOCAL and CalCOFI, April cruises.***

Objectives: To estimate spawning biomass of Pacific sardine from Baja California, México to San Francisco, CA, U.S.

Cooperating organizations:

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
Southwest Fisheries Science Center (SWFSC)	Nancy Lo	Nancy.Lo@noaa.gov
Instituto Nacional de la Pesca (INP)	Yanira Green	motagreen@yahoo.com.mx
Centro Interdisciplinario de Ciencias Marinas (CICESE)	Sarita De le Campa	scampa@cicese.mx

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
El Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICIMAR)	Martin Hernandez	mrivas@redipn.ipn.mx

Background: CalCOFI undertakes four cruises each year, in January, April, July and October. During the April cruise, four transects in the north are added to collect CUFES samples after the routine CalCOFI transects are finished. Starting in 2001, egg and larval data from CalVET and larval data from bongo are to be used in modeling egg mortality curve, and egg counts in CUFES are used to allocate additional CalVET samples if density of sardine eggs in CUFES is high.

IMECOCAL began in 1997. The number of cruises per year has increased from 1 in 1997 to 3 in 1998, 4 in 1999 and 4 in 2000. The four cruises within a year take place in January, April, July and October (and are timed to coincide with CalCOFI cruises). Data collected are similar to CalCOFI. Plankton nets include bongo for larvae, CalVET and CUFES to collect eggs. CTD casts provide temperature and salinity profiles to a maximum of 2000m. As few sardines appear in CalVET samples in each year, it was suggested to discontinue CalVET collections in the future. Martin Hernandez is analyzing larval and egg data from bongo, Yanira Green is analyzing egg samples from CalVET and Sarita de le Campa is sorting eggs from CUFES.

The sampling plan for CalCOFI and IMECOCAL is given in Figure 2.

Approaches: Sardine eggs and larvae will be collected during April cruises of IMECOCAL and CalCOFI in 2001. The staged eggs and yolk-sac larvae from both cruises will be used to estimate the daily egg production at age zero and the instantaneous mortality rate. Because sardine eggs from CUFES of IMECOCAL will be used for calculating daily egg production, a calibration factor between CUFES and CalVET has to be obtained. Therefore it is necessary to collect CalVET samples. It will be necessary to collect samples of hydrated females from commercial boats at the same time so that reproductive parameters can be estimated thereby making it possible to estimate spawning biomass (see Working Group I).

Starting Date: Nancy Lo will contact Yanira Green, Martin Hernandez, and Sarita de le Campa early 2001 to discuss the joint spawning biomass estimate logistics before the April cruises. Nancy Lo will also contact Eva Coterio (INP) and Beverly Macewicz regarding the adult samples.

Report Methods: The estimate of spawning biomass of Pacific sardine in 2001 will be reported in an article in the 2004 CalCOFI Reports. Other reports are currently in progress, e.g. Martin Hernandez will submit an article to CalCOFI Reports to report spawning biomass of Pacific sardine using larval census method based on larval data collected in 1997-2000. The annual spawning biomass of Pacific sardine off California is documented each year in a California Department of Fish and Game Administrative Report.

Reporting Deadlines: January 2003 for the preliminary results of spawning biomass of Pacific sardine from Baja California to San Francisco.

## ***2. NWFSC Egg Production Off Oregon.***

Objectives: To estimate spawning biomass of Pacific sardine off Oregon in 1994-1998 and reproductive parameters of adult sardine in 2001.

Cooperating organizations:

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
Northwest Fisheries Science Center (NWFSC)	Bob Emmett	robert.emmett@noaa.gov
Industry, Washington	Darrel Kapp	dkapp@netos.com
Southwest Fisheries Science Center	Nancy Lo	nancy.lo@noaa.gov
U.S. Industry	Darrel Kapp	dkapp@netos.com

Approaches: Because few hydrated females were collected in the trawl samples during the past cruises, it is urgent to find ways to locate fish schools during the peak spawning period. Mr. Kapp volunteered to provide a spotter plane to search for sardine schools in the offshore area because we believe that larger and older fish are most likely aggregated in the offshore area. Mr. Kapp indicated that it is impractical to send fishing vessels to trawl in the offshore area because fishing offshore may result in loss of value to the catch due to time to return to port. Due to limited manpower, Bob Emmett indicated that the NWFSC would not be able to conduct an Oregon/Washington coast sardine egg and larval survey. With the help of a spotter plane provided by Mr. Kapp, Bob Emmett planned to go offshore during July to gather hydrated females and other reproductive samples. Bob Emmett will also use the standard trawl area swept method to estimate the biomass of Pacific sardine, as done in Canadian waters. A relative abundance of Pacific sardine in 1998-2000 can be obtained from the surface trawl samples collected off the Columbia River off northern Oregon. Data from a June coast-wide survey in 1999-2001 may also be available.

Start Date: In April-May, 2001, Bob Emmett, Darrell Kapp and Nancy Lo will be discussing the logistics before the July cruises off Oregon. To obtain the egg production estimates for 1994-1998, Nancy Lo will begin working with Bob Emmett immediately.

Report Methods: Bob Emmett will include estimates of 1998-2000 relative abundance in a report on bait fishery abundance. The results of the estimates of spawning biomass of Pacific sardine off Oregon in 1994-1998 and the reproductive parameters in 2001 will be published in the 2003 CalCOFI Reports.

Reporting Deadlines:

The report on bait fishery abundance will be due in April 2001.

The preliminary results of the estimates of spawning biomass of Pacific sardine off Oregon in 1994-1998 and the reproductive parameters in 2001 will be available in June 2002 and the final results will be in the 2003 CalCOFI Reports.

### **3. *Aerial Spotted Surveys: Pacific NW And Baja California.***

Pacific NW: Mr. Kapp indicated that there are 4-6 spotter planes used in the sardine fishery. Mr. Kapp will ask his spotter pilot to search for sardine schools in the offshore area in July 2001.

Baja California: We are not certain at this moment.

### **4. *Canadian Trawl Surveys.***

Objectives: To provide information on the distribution of the presence/absence of sardine, biological parameters, and feeding behavior. To estimate a minimum biomass of Pacific sardine off Vancouver Island from July cruise each year since 1996.

#### Cooperating Organizations:

<u>Agency</u>	<u>Contact</u>	<u>Email</u>
Department of Fisheries & Oceans (DFO), Canada,	Sandy McFarlane	mcfarlanes@dfo-mpo.gc.ca
NWFSC	Bob Emmett	robert.emmett@noaa.gov
Canadian Industry	Don Pepper	dpepper@home.com
SWFSC	Nancy Lo	nancy.lo@noaa.gov

Approaches: The Canadian trawl survey is normally conducted 3-4 times a year. High-speed rope surface trawls are used. Data from the July survey has been used to estimate the minimum biomass in the offshore area, west of Vancouver Island while the biomass estimate nearshore came from data provided by industry. A coast-wide survey for hake will be conducted using the *Ricker* January 10 - February 11, 2001 from British Columbia to Baja California. Two sets per day will be allocated for sardine on this survey.

Start Date: January 2001 for *Ricker* coast-wide hake survey and July 2001 for routine surface trawl survey off Vancouver Island.

Report Methods: The minimum abundance of Pacific sardine using the swept area method for the west coast of Vancouver Island is between 80,000 - 100,000 ton and was reported in Beyond El Niño Report. Sandy McFarlane will write a technical report to document the detailed data collection of sardine samples from the trawl surveys from 1996 – the present.

Reporting Deadlines: Sandy McFarlane will finish a DFO technical report by the end of 2001.

### **5. *IMECOCAL, January Survey in South Baja California and Gulf of California (Fig 1C)***

Objectives: To estimate spawning biomass of Pacific sardine in the southern Baja California, México and in the Gulf of California and to investigate the migration of Pacific sardine between the Gulf and west of Baja California.

Cooperating Organizations:

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Approaches: Examine historical data of Pacific sardine in the Gulf of California prior to 1993. No estimate of spawning biomass was obtained due to poor quality of adult samples.

No other details were discussed at the working group meeting.

**Working Group 4 - Validation of Stock Structure and Latitudinal Origin of Catches**

Rapporteur: Paul E. Smith, Southwest Fisheries Science Center, USA

Working Group Participants:

John Butler – National Marine Fisheries Service, USA  
Tim Baumgartner – CICESE, Mexico

Objective: Test Vertebral Count method of separation of sardine by the temperature at origin.

Cooperating Organizations:

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Approach: Historical and contemporary collections of sardines will be examined for differences in vertebral counts attributed to the temperature of origin. Historical data on vertebral count in the sardine ranging from Gulf of California to San Pedro indicate that sardines spawned at 23 degrees have 49 vertebrae and those that spawned at the lower limit for survival and hatching, 13 degrees, have 54 vertebrae.

The primary emphasis will be on extending the range of collections from San Pedro to British Columbia in the north and to a few hundred miles offshore of Baja California, Southern California, Central California, Northern California, Oregon, Washington, and British Columbia.



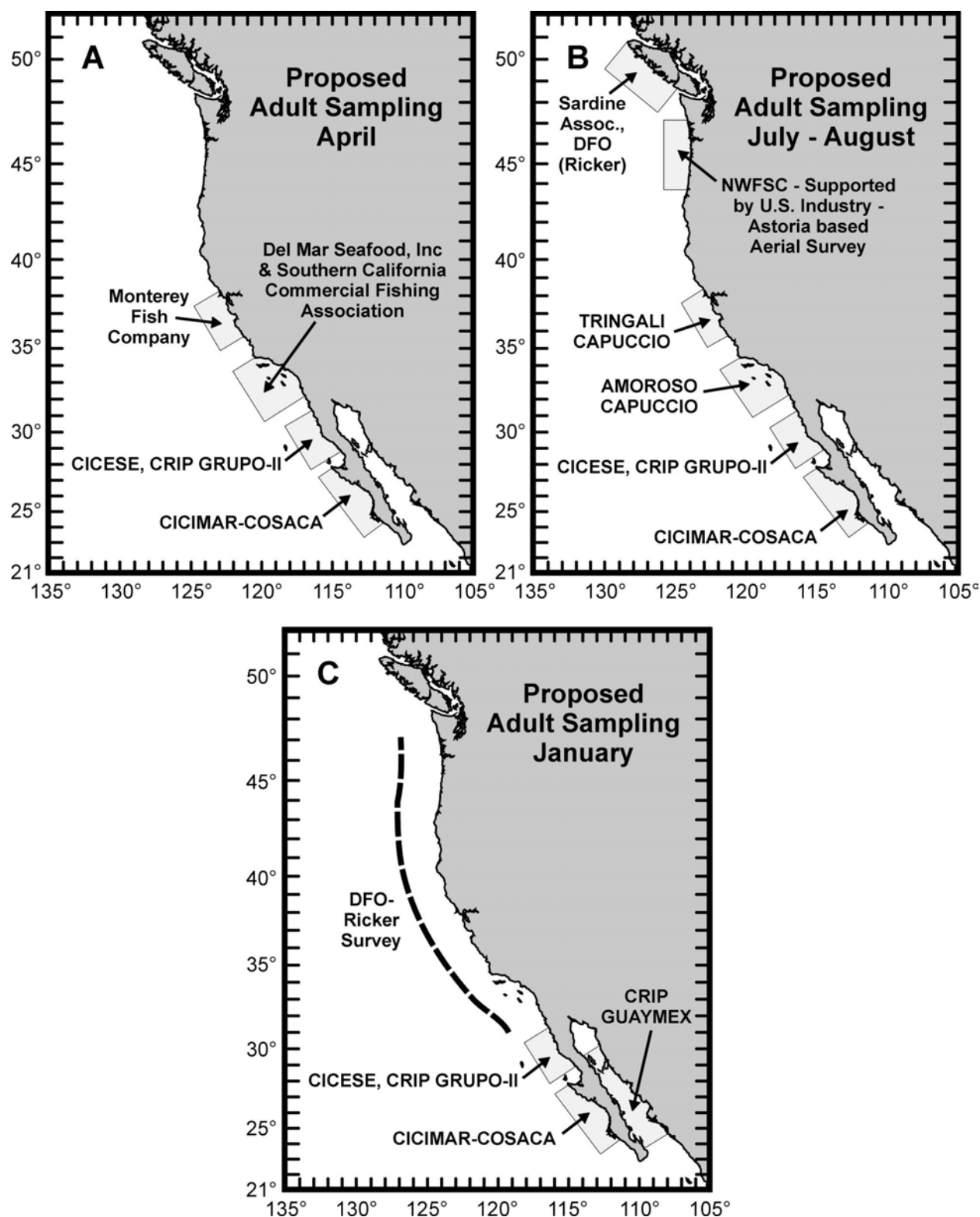
If preliminary work indicates that the temperature at hatching provide useful information on the latitude of origin, there will be two further projects:

- 1) Statistical procedures for assigning commercial catch to the stocks will be designed; and,
- 2) A designed study will be launched to determine the vital rates, natural mortality, age and size at maturation, growth rate, and fecundity.

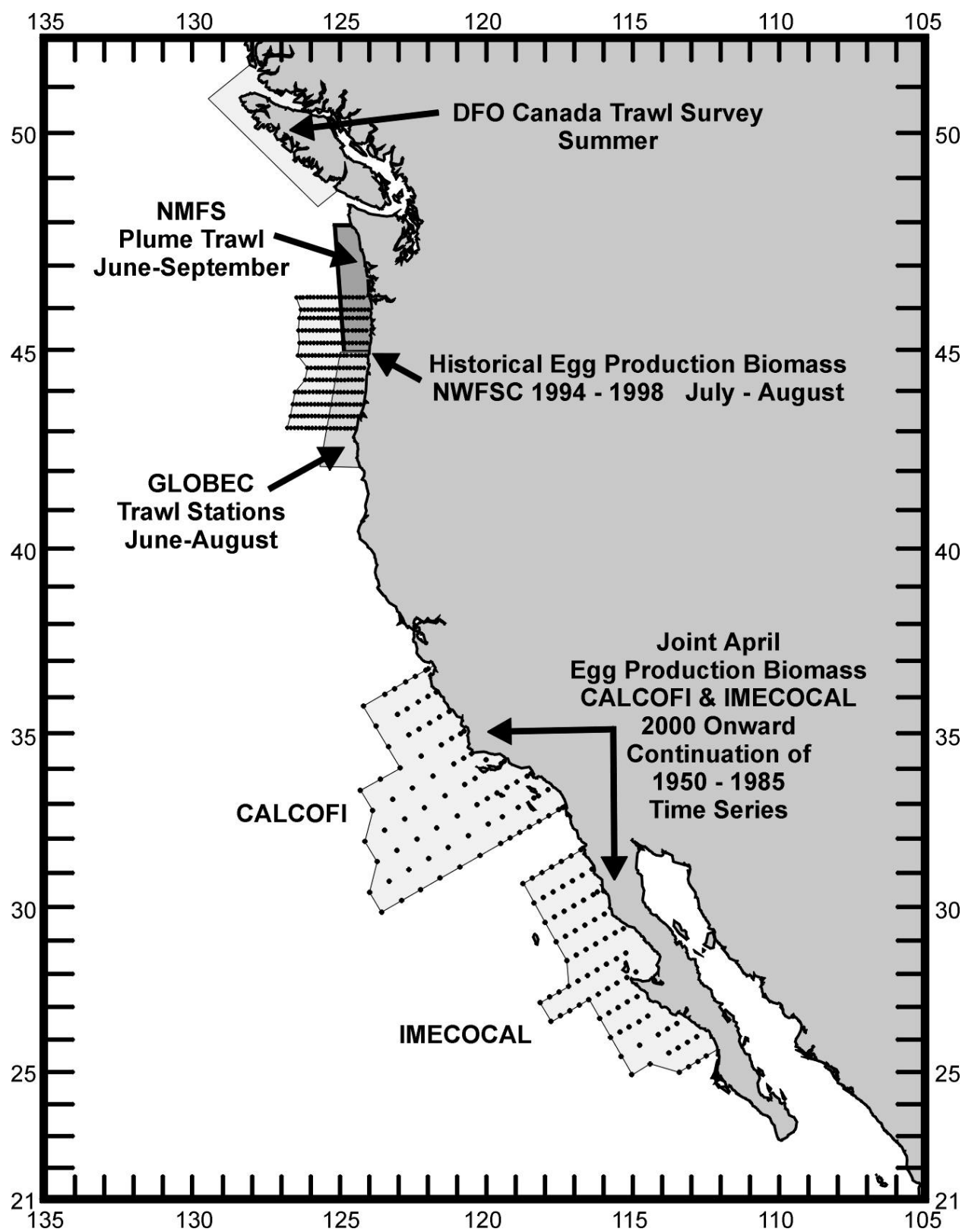
Start Date: Sardines off Oregon will be evaluated in mid-January 2001. Further studies will be conducted with the commercial catch and offshore sampling carried out by working group 1.

Reporting Method: Validation and conclusions will be forwarded to the population model revision team as each phase is concluded. Phase 1 - February 1, 2001, Phase II - July 1, 2001.

Reporting Deadline: The annual progress report should be submitted to the Forum organizers one month prior to the annual meeting.



**Figure 1.** Various adult sardine sampling schemes proposed in Trinational Sardine Forum. Implementation of any of these would substantially improve the information available for stock assessment.



**Figure 2.** Existing and past surveys of Pacific sardine along the West Coast of North America.

## APPENDIX I

# POTENTIAL RESEARCH ACTIVITIES ON PACIFIC SARDINE

This section provides an annotated list of potential research activities that would facilitate coast-wide assessment and monitoring of the Pacific sardine. The list is drawn from the one generated by the Sardine 2000 workshop Report (1) but contains fewer items. To construct this list we eliminated items cited in the Report that were too costly for the Forum to implement (such as coast-wide tagging studies, coast-wide biomass surveys using ships or airplanes, and electronic log book programs).

### 1) IMPROVE KNOWLEDGE OF AGE STRUCTURE OF THE POPULATION

Presently, sardine fishing (the primary source of specimens for age determination) is confined to a narrow band along the coast. Over most of their range, the larger fish are offshore beyond the present range of the fishery, and smaller and younger ones inshore. This bias in length sampling plus the fact that larger sardines carry out extensive coastal migrations seasonally produces a great many uncertainties regarding age and size structure of the population. This can be approached by age and length sampling in unfished regions up and down the coast.

### 2) DETERMINE AGE SPECIFIC REPRODUCTIVE EFFORT AND MONITOR SHIFTS IN MATURITY

Presently, management of the sardine does not take the age or size specific reproductive effort into account as regulations are simply based on the weight. Research over the last 20 years indicates that the annual reproductive output of female sardines and anchovies may increase faster with age than with weight. Thus, fishing quotas based only on catch weight may become very risky when population growth slows. As the population matures, grows more slowly, and begins to approach its maximum size for the current environmental conditions, it shall become increasingly dependent upon the greater reproductive output of the larger and older segments of the population. In addition, historic records from the California and Japanese sardine fisheries indicate that somatic growth slows in such large populations, and the age of first sexual maturity shifts from one year to two-year-old fish.

Currently, the population is still growing rapidly, perhaps at 30% or more per year. We do not know when this high rate of population growth will diminish and the demographic changes affecting per capita productivity of the population will occur. A precautionary approach to sardine management requires that as older and larger fish become a larger fraction of the catch, we shall need to take steps to preserve this older segment of the population. Increased catch of the older segments of the population might also occur as a result of higher market value. At present, we have no idea as to what reproductive value to attach to older mature fish relative to younger ones. Therefore, we need to know the age specific annual reproductive output of sardines and monitor to detect a shift in age at first reproduction.

Secondly, information on reproductive rates of Pacific sardine (eggs predicted per fish per day) is out of date. The last data collected was in 1994 when the population was much smaller. As this number is used to convert egg counts to biomass, it plays a vital role in stock assessment and needs to be updated.

This information can be obtained through:

- a) Histological approach to annual reproductive effort and maturity,
- b) Annual reproductive effort and maturity using gross anatomical criteria,
- c) Anatomical maturity only.

### **3) CONDUCT COAST WIDE BIOMASS SURVEY OR SURVEYS**

Presently, we really cannot be sure of the size of the sardine population; the actual value could be less than a million to several millions of tons. The most accurate way to determine how many sardines there are is to conduct a coast-wide biomass survey. Ideally, such a survey for sardine should be carried out every three years. Presently, fishery agencies do not have vessel time, or funds for a coast wide survey. At least three kinds of surveys could be considered:

- a) Acoustic Trawl survey,
- b) Sardine egg pump survey,
- c) Aerial survey.

### **4) SUPPLEMENTING REGIONAL BIOMASS ESTIMATES**

While a coast-wide coordinated biomass estimate is preferred, a more practical approach to a coast-wide estimate may be to fill gaps in coverage by adding additional regional surveys and combining surveys. Presently, CalCOFI egg and larval surveys in central and southern California waters detect high levels of spawning in April; IMECOCAL surveys also identify high spawning near Ensenada in April, but in addition there is a winter spawning peak in the south; a summer trawl survey for sardine exists in British Columbia which provides an index of abundance. This can be approached through:

- a) Combining data from April IMECOCAL + CalCOFI April surveys to estimate spawning biomass in northern Baja, southern and Central California,
- b) Conducting regional summer biomass trawl surveys in southern and central California, and México similar to the one in British Columbia.

### **5) IDENTIFYING MOVEMENTS AND REGIONAL RESIDENCY PERIODS**

Key biological questions regarding movements and stock assessment, are 1) elimination of the confusion between age structure and movements and assignment as to the proper attribution and statistical weights to regional estimates of biomass; and 2) relative contribution of the recruits from one region to the biomass of another. To eliminate the confusion we need to know: the age and length, at which annual north-south migrations commence; the extent the duration and length of north-south migrations are affected by sardine size, age, starting point, and environmental

conditions (sea surface temperatures); the duration and the factors affecting residency periods of juveniles and adult sardine particularly at the northern end of their range.

These questions can be approached by:

- a) Conventional mark and recapture,
- b) Micro-constituents composition of otoliths,
- c) Archival, pop-up and other advanced tracking methodologies.

## **6) GENERAL UNDERSTANDING OF SARDINE BIOLOGY AND ECOLOGY**

While not necessarily a direct part of an assessment, better understanding of the ecology and biology of sardine can make very important conceptual contributions to their management over the long-term. Science projects identified in the 2000 meeting are centered on the investigation of:

- a) Spawning rates and batch fecundity,
- b) Oil yield,
- c) Food habits,
- d) Spawning habitat identification.

## APPENDIX II

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Ensenada, México  
November 28 - December 2, 2000**

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## APPENDIX III

### ACRONYMS

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CalVET	CalCOFI vertical egg tow
CANSAR	Catch at age analysis for sardine
CDF&G	California Department of Fish and Game
CICESE	Centro Interdisciplinario de Ciencias Marinas
CICIMAR	El Centro de Investigacion Cientifica y de Educacion Superior de Ensenada
CRIP	Centro Regional de Investigaciones Pesqueras de Quaymas
CTD	Conductivity-Temperature-Density (or depth)
CUFES	Continuous Underway Fish Egg Sampler
DFO	Department of Fisheries and Oceans, Canada
EPCOR-IAI	Inter-American Institute for Global Change Research
IMECOCAL	Investigaciones Mexicanas de la Corriente de California
INP	Instituto Nacional de la Pesca
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
SWFSC	Southwest Fisheries Science Center